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## ABSTRACT

This study compared male and female enrollment and achievement in high school physics courses. The expectations were that enrollment of females would be higher than the 35 percent reported in a 1969 study and that the achievement of the sexes would be equal. The findings indicated that the percentages of females were very similar to those in the earlier study, indicating that participation by females in physics courses is not increasing. With regard to achievement, the results showed practically no differences between the sexes; females generally scored as well as males. Since failure to take high school physics means fewer options as a college student, movement toward greater numbers of women in technical fields will continue to be very gradual. (Author)

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# High School Physics: A Male Domain?

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Running head: HIGH SCHOOL PHYSICS

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#### Abstract

This study compared male and female enrollment and achievement in high school physics courses. The expectations were that enrollment of females would be higher than the 35% reported in a 1969 study and that the achievement of the sexes would be equal. The findings indicated that the percentages of females were very similar to those in the earlier study, indicating that participation by females in physics courses is not increasing. With regard to achievement, the results showed practically no differences between the sexes; females generally scored as well as males. Since failure to take high school physics means fewer options as a college student, movement toward greater numbers of women in technical fields will continue to be very gradual.

## High School Physics: A Male Domain?

The objective of this study was to examine trends in female enrollment in high school physics courses and to compare male and female achievement on a state-wide high school examination in physics. This research is part of a larger longitudinal study designed to examine trends relating to sex differences in enrollment and achievement in science and mathematics.

The National Science Foundation (1984) reported a 200% increase in the employment of women scientists and engineers between 1972 and 1982, compared with an increase of approximately 40% for men. In 1982, 13% of the science and engineering work force were women, approximately double their numbers in 1972.

Yet the number of women employed as physicists remains markedly low. Rossi (1965) reported a 4% figure for 1960, even though the corresponding percentages in biology and mathematics were 27 and 26, respectively. Over twenty years later Max (1982) found fewer than one in 20 physicists was a female. The figures for 1982, which included physicists and astronomers, showed that 5.7% of those employed in science and engineering were women. At the doctoral level, 3.1% of the physicists/astronomers were women.

Walberg (1969) reported that 13% of high school physics teachers were females. Unpublished figures for New York State indicate that in 1983-84 the percentage of female high school physics teachers was also 13%. In contrast, in New York in 1983-4, in two fields typically dominated by male teachers, 37% of eleventh year mathematics (trigonometry) teachers and 21% of chemistry teachers were female.

In 1980, 26% of male high school seniors were enrolled in physics courses compared with 14% for female high school seniors (National Center for Education Statistics, 1981). The finding that males were approximately twice as likely to enroll in physics was also reported by Walberg (1969). Swartz (1981) reported that 35% of the students in his survey were females. He considered this percentage a "happy fact," not knowing whether it reflected a bias in the survey or a trend in enrollment. The percentage of female college-bound seniors taking the College Entrance Examination Board achievement test in physics was 23.7 in 1983 (College Entrance Examination Board, 1984). In 1978, Remick and Miller (1978) found at the University of Washington that only 25% of Caucasian females in their sample had completed a high school physics course compared to 78% for Caucasian males.

With regard to achievement in physics, the findings generally favor males. Walberg (1969) found that males scored significantly higher than females on a physics achievement test. Males typically outscore females on the physics achievement test administered by the College Entrance Examination Board (1983). For example, the scores for males and females were respectively 606 and 548 in 1981, and 606 and 550 in 1983. Erickson and Erickson (1984) cite considerable evidence that females score below males in tests of science achievement, although the differences have not been uniform across subject areas. Males clearly outperform females in the physical sciences, especially physics, while in the biological sciences the male advantage is not as large.

According to Remick and Miller (1978), high school physics has several important functions: it exposes students to a field of study they are unlikely simply to chance upon, and it is a prerequisite for many fields of study, including at the University of Washington, for example, astronomy, chemistry, computer science, engineering, environmental health, forest resources, geological sciences, oceanography, pharmacy and physics.

#### Expectations

The primary objective of the study was to determine how the participation rates of females in high school physics in New York State compare with those of previous studies. In terms of participation, it was the expectation of this research that the enrollment of females in physics courses would be somewhat higher than the 35% reported for a national sample by Walberg (1969). Since recent College Board data have suggested that the participation of high school females in mathematics has gradually increased over the last 15 years, one might expect that physics participation also would have increased.

The second objective of the study was to determine if the achievement of females in New York State as measured by scores on the New York State Regents examination in physics was comparable to that of males. The expectation was that the achievement of females would be approximately equal to that of males. It was hypothesized that for the population there would be a very small advantage in favor of males in terms of mean scores on the physics Regents examinations.

## Method

Sample

As a pilot study, a sample of Regents examination papers in physics for the June 1978 examination was obtained from the State Education Department. The sample was comprised of approximately 1,800 June 1978 Regents physics examination papers. The student papers came from 32 schools; 47 different teachers were represented. Of the 1,831 students, 1266 were male and 565 were female (Table 1). The mean score for males was 79.65, for females 78.85, a difference of .80 in favor of males. That is, using the 1978 physics data as a basis for generating hypotheses, we then hypothesized that the enrollment in physics in New York State was approximately two to one in favor of males. In terms of achievement we hypothesized for 1979, 1980, and 1981 that in the population there was no difference between the mean scores on the physics Regents examination.

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Insert Table 1 about here.

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For monitoring purposes the New York State Education Department annually draws a 5 to 8% sample which is roughly representative of schools across the state and which includes schools that are small, large, urban, and rural. The 1979, 1980, and 1981 review samples of the physics Regents examination were made available for this study. Together with the 1978 data, the total sample consisted of 7,813 physics examination papers from 203 schools representing 263 different teachers.

Instrument

The Regents examinations in New York State are annually given to all the students in the state who are working toward a state (Regents) diploma. The physics examination was given to 60,000 students in 1979, 65,000 in 1980 and 70,000 in 1981. Based on a recognized statewide curriculum in physics, the Regents examinations are important features of the instructional process of New York State. Regents examinations are three hours in length; their contents are secure until the time of the examination.

Annually the New York State Education Department publishes descriptive statistics concerning the review samples and the pass-fail rates for all of the Regents examinations conducted in the previous year. According to the State Education Department, the reliabilities (Kuder-Richardson 21) for the 1979, 1980, and 1981 physics Regents examinations were all above .90.

Results and Discussion

Table 1 shows that in the four samples approximately two-thirds of the students were males and one-third females. It would not appear that there was any noticeable change in participation over the four years based on these samples. For the four years, 1978-1981, the percentages of females taking the examinations were 34.9, 34.8, 35.4, and 35.3, respectively. It would appear that the enrollment results in New York State over the past few years are similar to those reported by Walberg in 1969 and by Swartz in 1981. The results of this study do not provide any evidence to support the belief that the percentage of high school females in physics is increasing. It appears that the one to two ratio which probably has been in existence

nationally for 20 years is unchanged.

The mean scores, by sex, on the four Regents physics examinations are presented in Table 1. Overall, the mean scores for males and females are very similar. The largest difference is 2 points in favor of males; the other three differences are smaller than 1 point. For 1978, 1979, and 1980, the differences are not statistically significant at the .05 level. Thus, the null hypothesis of no difference between the means in the population is supported. Even though the mean difference for 1981 is statistically significant, the difference is probably not practically significant. Thus, for the four examinations, it appears that for the state as a whole the females who took the physics Regents examinations did as well as the males.

There would seem to be some good news and some bad news in these results. The good news would seem to be that the females who are in the high school physics courses do as well as their male colleagues. This finding runs a bit contrary to the notion that science and mathematics are subjects in which males excel. The bad news seems to be that the picture of enrollment in physics over the past 15 to 20 years has changed very little. If, as Remick and Miller (1978) have pointed out, failure to take high school physics means substantially fewer options as a college student, then it would appear that the move toward greater numbers of women in technical fields will continue to be very gradual for substantial numbers of college women. Some of the more prestigious, interesting, and well paying careers will continue in the near future to be substantially unrepresented by women.

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Table 1  
Mean and Standard Deviation, by Sex, of Student Performance on  
Four New York State Regents Examinations in Physics

| Examination<br>Date (June) | Females  |          |           | Males    |          |           | Difference | <u>t</u> |
|----------------------------|----------|----------|-----------|----------|----------|-----------|------------|----------|
|                            | <u>n</u> | <u>M</u> | <u>SD</u> | <u>n</u> | <u>M</u> | <u>SD</u> |            |          |
| 1978                       | 565      | 78.8     | 11.4      | 1266     | 79.6     | 12.6      | 0.8        | 1.33     |
| 1979                       | 646      | 77.3     | 11.5      | 1212     | 77.8     | 12.2      | 0.5        | .88      |
| 1980                       | 803      | 76.5     | 12.9      | 1467     | 76.4     | 13.6      | -0.1       | -.17     |
| 1981                       | 731      | 76.1     | 13.4      | 1337     | 78.1     | 12.3      | 2.0        | 3.33*    |

Note. N = 7,813

\*p < .001